

Listing of Claims:

1. (Withdrawn) A ball-limiting metallurgy, comprising:
 - a substrate;
 - a barrier layer formed over the substrate;
 - an adhesion layer formed over the barrier layer;
 - a first solderable layer formed over the adhesion layer;
 - a diffusion barrier layer formed over the adhesion layer; and
 - a second solderable layer formed over the diffusion barrier layer.
2. (Withdrawn) The ball-limiting metallurgy of claim 1, wherein the first solderable layer is made of copper.
3. (Withdrawn) The ball-limiting metallurgy of claim 2, wherein the diffusion barrier layer is made of CoWP.
4. (Withdrawn) The ball-limiting metallurgy of claim 1, wherein the second solderable layer is made of Ni.
5. (Withdrawn) The ball-limiting metallurgy of claim 1, wherein the barrier layer, the adhesion layer, the first solderable layer, the diffusion barrier layer, and the second solderable layer are surrounded by a polyimide layer.
6. (Withdrawn) An interconnection structure for flip-chip attachment of microelectronic device chips to packages, comprising:
 - a ball-limiting metallurgy comprising:
 - a barrier layer formed over the microelectronic device chip;
 - an adhesion layer formed over the barrier layer;
 - a first solderable layer formed over the adhesion layer;
 - a diffusion barrier layer formed over the adhesion layer; and
 - a second solderable layer formed over the diffusion barrier layer; and
 - at least one lead-free solder ball formed over the second solderable layer.

7. (Withdrawn) The interconnection structure of claim 6, wherein the first solderable layer is made of copper.

8. (Withdrawn) The interconnection structure of claim 7, wherein the diffusion barrier layer is made of CoWP.

9. (Withdrawn) The interconnection structure of claim 6, wherein the second solderable layer is made of Ni.

10. (Withdrawn) The interconnection structure of claim 6, wherein the barrier layer, the adhesion layer, the first solderable layer, the diffusion barrier layer, and the second solderable layer are surrounded by a polyimide layer.

11. (Withdrawn) The interconnection structure of claim 6, wherein the at least one lead-free solder ball is made of a tin alloy.

12. (Currently Amended) A method for forming an interconnection structure for flip-chip attachment of microelectronic device chips to packages, comprising:

forming a barrier layer over a substrate;

forming an adhesion ~~adesion~~ layer over the barrier layer;

forming a resist layer over the adhesion layer, the resist layer having an opening that exposes the adhesion layer;

forming a first solderable layer over the adhesion layer through the opening in the resist layer, wherein the first solderable layer comprises Cu;

forming a diffusion barrier layer over the first solderable layer through the opening in the resist layer, wherein the diffusion barrier layer comprises CoWP;

forming a second solderable layer over the diffusion barrier layer through the opening in the resist layer, wherein the second solderable layer comprises Ni;

removing the resist layer;

removing portions of the barrier layer and the adhesion layer that extend beyond the first solderable layer, the diffusion barrier layer and the second solderable layer; and

forming at least one solder ball over the second solderable layer.

13. (Original) The method of claim 12, further comprising forming a polyimide layer around the barrier layer, the adhesion layer, the first solderable layer, the diffusion barrier layer and the second solderable layer.

14. (Original) The method of claim 12, wherein the step of forming the barrier layer comprises sputtering.

15. (Original) The method of claim 12, wherein the step of forming the adhesion layer comprises sputtering.

16. (Original) The method of claim 12, wherein the step of forming the first solderable layer comprises electroplating.

17. (Original) The method of claim 12, wherein the step of forming the diffusion barrier layer comprises electroless deposition.

18. (Original) The method of claim 12, wherein the step of forming the second solderable layer comprises electroplating.

19. (Canceled)

20. (Canceled)

21. (Canceled)

22. (Currently Amended) The method of claim 12, wherein the step of forming the ~~lead-free~~ solder ball comprises forming the lead-free solder ball by at least one of electroplating, solder screening, exchange plating, and electroless deposition.

23. (Currently Amended) A method for forming an interconnection structure for flip-chip attachment of microelectronic device chips to packages, comprising:

forming a barrier layer over a substrate;

forming an adhesion ~~adesion~~ layer over the barrier layer;

forming a first solderable layer over the adhesion layer, wherein the first solderable layer comprises Cu;

forming a diffusion barrier layer over the first solderable layer, wherein the diffusion barrier layer comprises CoWP;

forming a second solderable layer over the diffusion barrier layer, wherein the second solderable layer comprises Ni; and

forming at least one solder ball over the second solderable layer.

24. (Original) The method of claim 23, wherein the step of forming the first solderable layer comprises:

forming a resist layer over the adhesion layer, the resist layer having an opening that exposes the adhesion layer; and

electroplating the adhesion layer over the adhesion layer through the opening in the resist layer.

25. (Original)The method of claim 24, wherein the step of forming the diffusion barrier layer comprises electroless deposition of the diffusion barrier layer over the first solderable layer through the opening in the resist layer.

26. (Original)The method of claim 25, wherein the step of forming the second solderable layer comprises electroplating the second solderable layer over the diffusion barrier layer through the opening in the resist layer.

27. (Original)The method of claim 25, further comprising:

removing the resist layer after the first solderable layer, the diffusion barrier layer and the second solderable layer are formed; and

removing portions of the barrier layer and the adhesion layer that extend beyond the first solderable layer, the diffusion barrier layer and the second solderable layer after the resist layer is removed.

28. (Original)The method of claim 23, further comprising forming a polyimide layer around the barrier layer, the adhesion layer, the first solderable layer, the diffusion barrier layer and the second solderable layer.

29. (Canceled)